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THE COMPARATIVE ANALYSIS OF ATTENDANT SUBDIVISION'S FORMALIZED COST SHARING METHODS (CSM)

The comparative analysis of the formalized earlier by us methods of expenses distribution by criteria of exactness, labour – intensiveness and self-descriptiveness is executed. It is shown, that the two-stages method of the mutual distribution most precisely and in details describes process of expenses distribution of the attendant subdivisions, insignificantly conceding to the other methods by labour – intensiveness.

Actuality of task. Complexity of the attendant subdivision's cost sharing process between production department influences labour-intensiveness and accuracy of products prime cost calculation. The number of CSM presented in literature [1,2] possesses essential lack - weak formalization that limits their application, especial for the enterprises with the big number of subdivisions. As a result the problem of CSM improvement is rather actual.

Definition of unsolved problems. In articles [3,4] formalization of simultaneous and direct distribution methods is offered on the basis of matrix calculation, and the comparative characteristic of these methods is executed. In work [5] formalization of other CSM - successive and two-stages mutual distribution is offered. Now it is necessary to execute a comparative estimation of the formalized CSM.

Target setting. The purpose of this work - is comparative analysis of the formalized CSM by criteria of exactness, labour-intensiveness and self-descriptiveness.

Research results. The solution of the set task we'll carry out by CSM comparison concerning the specified criteria, it is similar to the way how it is made in the article [4]. For this purpose we'll compare results of CSM calculation, received by various methods, for the one example.

Example. A machine-building enterprise has three basic workshops: mechanical 1 (M1), mechanical 2 (M2), mechanical 3 (M3) and five attendant subdivisions: warehousing (storage), maintenance shop (MS), toolroom (TR), department of energy (DE) and shipping department (SD). In the table 1 the overhead costs of subdivisions are resulted, and the table 2 represents distribution of attendant subdivisions services. It is required to define the general sum of overhead costs for basic workshops.

Table 1. Basic data for distribution of expenses

INDEX	Subdivisions								
	M1	M2	M3	Storage	MS	TR	DE	SD	Total
Overhead expenses, thousand of Uah	3120	3640	4160	1700	1600	1850	2200	2100	20370

Table 2. Distribution of attendant subdivisions services

Subdivision as user of services	Subdivision, giving services				
	Storage	MS	TR	DE	SD
M1	16%	19%	14%	17%	10%
M2	20%	26%	30%	22%	12%
M3	26%	34%	46%	28%	18%
Storage	*	2%	–	7%	43%
MS	14%	*	10%	11%	4%
TR	12%	11%	*	12%	6%
DE	7%	5%	–	*	7%
SD	5%	3%	–	3%	*

On the basis of information in the tables 1 and 2 we'll enter denomination of the subdivisions aggregated expenses: X_1 are workshops of M1; X_2 are workshops of M2; X_3 are workshops of M3; X_4 – storage X_5 – MS; X_6.– TR; X_7 – DE; X_8 – SD.

In the beginning we will consider the method of simultaneous mutual services distribution. For this purpose we will make an equation of connection between the aggregated, own and mutual expenses of workshop of M1:

$$X_1 = 3120 + 0.16X_4 + 0.19X_5 + 0.14X_6 + 0.17X_7 + 0.1X_8. \quad (1)$$

Similarly we will compose equations for other subdivisions and will get the system of equalizations, which looks like in the unfolded matrix form:

$$\begin{bmatrix} 1 & 0 & 0 & -0{,}16 & -0{,}19 & -0{,}14 & -0{,}17 & -0{,}1 \\ 0 & 1 & 0 & -0{,}2 & -0{,}26 & -0{,}3 & -0{,}22 & -0{,}12 \\ 0 & 0 & 1 & -0{,}26 & -0{,}34 & -0{,}46 & -0{,}28 & -0{,}18 \\ 0 & 0 & 0 & 1 & -0{,}02 & 0 & -0{,}07 & -0{,}43 \\ 0 & 0 & 0 & -0{,}14 & 1 & -0{,}1 & -0{,}11 & -0{,}04 \\ 0 & 0 & 0 & -0{,}12 & -0{,}11 & 1 & -0{,}12 & -0{,}06 \\ 0 & 0 & 0 & -0{,}07 & -0{,}05 & 0 & 1 & -0{,}07 \\ 0 & 0 & 0 & -0{,}05 & -0{,}03 & 0 & -0{,}03 & 1 \end{bmatrix} \times \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \\ X_6 \\ X_7 \\ X_8 \end{bmatrix} = \begin{bmatrix} 3120 \\ 3640 \\ 4160 \\ 1700 \\ 1600 \\ 1850 \\ 2200 \\ 2100 \end{bmatrix} \quad (2)$$

If to designate in system (2) square matrix of correlations (MC) through A, matrix-column of the unknown aggregated expenses (MAE) through X and matrix-column of own expenses (MOE) through B, then the system of equations, linking the own and aggregated expenses of subdivisions, will be written down as:

$$A \times X = B. \quad (3)$$

From the system (3) we can find the matrix of the unknown aggregated expenses:

$$X = A^{-1} \times B, \quad (4)$$

where A^{-1} – is a matrix which reverse to matrix A.

The decision of system (2):

$$X_1 = 5231; X_2 = 6720; X_3 = 8419; X_4 = 2981;$$
$$X_5 = 2710; X_6 = 2976; X_7 = 2713; X_8 = 2412. \quad (5)$$

A notation of the systems (3, 4) is the same for all CSM. The difference between them is only in composition of matrices of correlation A.

The calculation results of cost distribution by various methods are submitted in table 3. From this calculation we can see, that the method of mutual distribution is the most exact and informative as it reflects balance of overhead expenses distribution not only for main, but for all subdivisions.

Therefore exactness of the remaining CSM we'll estimate concerning a method of mutual distribution, having taken its results for base. Measure of exactness will be relative error (δ)

Table 3. Overhead expenses distribution between subdivisions by various methods

№	Method of distribution	Subdivision									
		M1	M2	M3	Storage	MS	TR	DE	SD	All main	All auxiliary
1	Direct	5317	6683	8370	1700	1600	1850	2200	2100	20370	9450
2	Successive	5207	6721	8442	2856	2389	2935	2200	2166	20370	12546
3	Simultaneous	5231	6720	8419	2981	2710	2976	2713	2412	20370	13792
4	Mutual	5264	6705	8401	1805	1946	2359	1898	1441	20370	9450

Therefore results clearage of the overhead expenses distribution, received by remained methods, we estimate regarding to the results received with the method of mutual distribution, using data from table 3. For example: $X^{np}{}_1 / X^{в}{}_1 = 5317/5264 = 1{,}010$. Where: $X^{np}{}_1$, $X^{в}{}_1$ - the generalized overhead expenses of subdivision M1 received by the method of direct and mutual distribution, accordingly. The data of clearage is brought in table 4.

Table 4. - Results clearage of the overhead expenses distribution by various methods

№	Method of distribution	Subdivisions		
		M1	M2	M3
1	Direct	$\frac{5317}{5264} = 1{,}01;$ $\delta = 1\%.$	$\frac{6683}{6705} = 0{,}996;$ $\delta = -0{,}4\%.$	$\frac{8370}{8401} = 0{,}996;$ $\delta = -0{,}4\%.$
2	Successive	$\frac{5207}{5264} = 0{,}989;$ $\delta = -1{,}1\%.$	$\frac{6721}{6705} = 1{,}002;$ $\delta = 0{,}2\%.$	$\frac{8442}{8401} = 1{,}004;$ $\delta = 0{,}4\%.$

3	Simultaneous	$\frac{5231}{5264} = 0{,}993;$ $\delta = -0{,}7\%.$	$\frac{6720}{6705} = 1{,}002;$ $\delta = 0{,}2\%.$	$\frac{8419}{8401} = 1{,}002;$ $\delta = 0{,}2\%.$

Comparing data from the table 4, we can see that the maximal results clearage of the overhead expenses distribution provides by the method of successive distribution. In our example it does not exceed 1,1 % ($\frac{X^{n}_{1}}{X^{e}_{1}} = 5207/5264 = 0{,}989).$ Where X^{n}_{1} - the generalized overhead expenses of the subdivision M1 received by the method of successive distribution.

Ass we can see from expression (4), for an imprecision limit estimation of the results of distribution it is necessary to compare inverse matrixes of correlation for various methods of distribution: $A^{-1}_{1}, A^{-1}_{2}, A^{-1}_{3}, A^{-1}_{4}$ - direct, successive, simultaneous and mutual accordingly. In our case:

$$A^{-1}_{1} = \begin{bmatrix} 1 & 0 & 0 & 0.258 & 0.241 & 0.156 & 0.254 & 0.25 \\ 0 & 1 & 0 & 0.323 & 0.329 & 0.333 & 0.328 & 0.3 \\ 0 & 0 & 1 & 0.419 & 0.43 & 0.511 & 0.418 & 0.45 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix},$$

$$A^{-1}_{2} = \begin{bmatrix} 1 & 0 & 0 & 0.24 & 0.23 & 0.156 & 0.238 & 0.238 \\ 0 & 1 & 0 & 0.325 & 0.33 & 0.333 & 0.328 & 0.315 \\ 0 & 0 & 1 & 0.435 & 0.44 & 0.511 & 0.434 & 0.447 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0.084 & 0.463 \\ 0 & 0 & 0 & 0.159 & 1 & 0 & 0.125 & 0.117 \\ 0 & 0 & 0 & 0.156 & 0.122 & 1 & 0.149 & 0.142 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.03 & 1 \end{bmatrix},$$

$$A^{-1}{}_3 = \begin{bmatrix} 1 & 0 & 0 & 0.241 & 0.232 & 0.163 & 0.239 & 0.239 \\ 0 & 1 & 0 & 0.329 & 0.329 & 0.333 & 0.328 & 0.316 \\ 0 & 0 & 1 & 0.434 & 0.439 & 0.504 & 0.433 & 0.445 \\ 0 & 0 & 0 & 1.035 & 0.039 & 3.927*10^{-3} & 0.091 & 0.453 \\ 0 & 0 & 0 & 0.172 & 1.026 & 0.103 & 0.141 & 0.131 \\ 0 & 0 & 0 & 0.157 & 0.126 & 1.013 & 0.151 & 0.144 \\ 0 & 0 & 0 & 0.085 & 0.056 & 5.644*10^{-3} & 1.016 & 0.11 \\ 0 & 0 & 0 & 0.059 & 0.034 & 3.443*10^{-3} & 0.039 & 1.03 \end{bmatrix},$$

$$A^{-1}{}_4 = \begin{bmatrix} 1 & 0 & 0 & 0.246 & 0.234 & 0.163 & 0.243 & 0.245 \\ 0 & 1 & 0 & 0.324 & 0.329 & 0.333 & 0.328 & 0.31 \\ 0 & 0 & 1 & 0.430 & 0.437 & 0.504 & 0.429 & 0.445 \\ 0 & 0 & 0 & 0.736 & 0.019 & 1.742*10^{-3} & 0.045 & 0.2 \\ 0 & 0 & 0 & 0.098 & 0.84 & 0.076 & 0.083 & 0.054 \\ 0 & 0 & 0 & 0.096 & 0.091 & 0.917 & 0.097 & 0.067 \\ 0 & 0 & 0 & 0.044 & 0.033 & 3.043*10^{-3} & 0.758 & 0.046 \\ 0 & 0 & 0 & 0.026 & 0.017 & 1.543*10^{-3} & 0.017 & 0.633 \end{bmatrix}.$$

According to [4], maximum deviations of the distribution results can be estimated by relation of the generalized factors which are defined as the elements sum of corresponding lines of the inverse matrixes $A^{-1}{}_1, .A^{-1}{}_2, A^{-1}{}_3, A^{-1}{}_4$. For example, the generalized factors of the matrix of the successive distributions method (matrix $A^{-1}{}_2$) are defined as:

$K^n{}_{o1} = 1 + 0,$ 24+0,23+0,156+0,238+0,238=2,102;

$K^n{}_{o2} = 1 + 0{,}325 + 0{,}33 + 0{,}333 + 0{,}328 + 0{,}315 = 2{,}631;$

$K^n{}_{o3} = 1 + 0{,}435 + 0{,}44 + 0{,}511 + 0{,}434 + 0{,}447 = 3{,}267.$

Calculation results of maximal deviations are resulted in the table 5.

Table 5. Maximal deviations of the overhead expenses distribution results by various methods

№	Method of distribution	Generalized factors			Maximal deviation		
		Subdivisions			Subdivisions		
		M1	M2	M3	M1	M2	M3
1	Direct	2,159	2,613	3,228	$\frac{2,159}{2,131}=1,013;$ $\delta=1,3\%.$	$\frac{2,613}{2,624}=0,995;$ $\delta=-0,5\%.$	$\frac{3,228}{3,245}=0,994;$ $\delta=-0,6\%.$
2	Successive	2.102	2.631	3.267	$\frac{2,102}{2,131}=0,986;$ $\delta=-1,4\%.$	$\frac{2,631}{2,624}=1,002;$ $\delta=0,2\%.$	$\frac{3.267}{3.245}=1.006;$ $\delta=0,6\%.$
3	Simultaneous	2.114	2.631	3.255	$\frac{2,114}{2,131}=0,992;$ $\delta=-0,8\%.$	$\frac{2,631}{2,624}=1,002;$ $\delta=0,2\%.$	$\frac{3.255}{3.245}=1.003;$ $\delta=0,3\%.$
4	Mutual	2.131	2.624	3.245	$\frac{2.131}{2.131}=1.0;$ $\delta=0\%.$	$\frac{2,624}{2,624}=1,0;$ $\delta=0\%.$	$\frac{3,245}{3,245}=1,0;$ $\delta=0\%.$

From the table 5 we can see, that the least exact is method of successive distribution, which provides the biggest deviation of results ($\delta=1.4\%$). The method of simultaneous distribution according to exactness concedes only to the method of mutual distribution.

Comparing data from the table 3, it is not difficult to notice, that the method of mutual distribution is the most informative. Unlike the other CSM it gives full picture of costs distribution during rendering services of auxiliary subdivisions as each to other (mutual), and to the main production units. As we can see from the data presented in the table 1, that TR 1) has rendered service for the other divisions to the amount of 1850 thousand Uah., which are considered as own expenses. But thus TR uses services of storage, DE, SD (mutual services). Taking into account mutual services, full expenses of TR have made up 2359 thousand Uah., i.e. increased on 509 thousand Uah. in comparison with own expenses. It means that in mutual services TR has received more from other subdivisions, than gave them. For SD - the situation is opposite, therefore full expenses of SD (1441 thousand Uah.) – less then own (2100 thousand Uah.).

In the method of direct distribution mutual redistribution of expenses between auxiliary subdivisions is not reflected at all. In this method all own expenses of auxiliary subdivisions in the sum of 9450 thousand Uah. at once and are completely transferred to the main production subdivisions. Methods of successive and simultaneous distribution reflects not completely process of costs distribution between auxiliary subdivisions, as they only shows reception of services to the given subdivision from other subdivisions and don't shows feedback (rendering of services by the given subdivision to another auxiliary subdivision). Therefore for successive and simultaneous distribution methods the balance of auxiliary subdivision expenses (12546 thousand Uah and 13792 thousand Uah., accordingly instead of 9450 thousand Uah.).

The analysis of presented in [3-5] formalized CSM concerning criteria of labour–intensiveness allows making the following summary. The method of simultaneous distribution is the easiest, the least labour–intensiveness for practical application. The methods of direct and successive distribution concede him at labour–intensiveness, approximately in the same measure, as by criteria of exactness. The method of mutual distribution on labour–intensiveness insignificantly concedes to methods of direct and successive distribution as it is two-stages.

Summary:

1. The two-stages method of mutual distribution most precisely and in details describes the process of attendant subdivisions costs distribution, insignificantly conceding to the other methods on labour–intensiveness.

2. The rest methods (direct, successive and simultaneous distribution) describes precisely only costs distribution of auxiliary subdivisions to the main, not considering in general (a direct method) or considering partly auxiliary subdivisions mutual services distribution. At the same time the method of simultaneous distribution is the most exact, the most easiest and the least labour–intensiveness for

practical usage. A limiting error of this method concerning to the method of mutual distribution is equal 1 %.

3. For the purposes of calculation of the prime cost it is enough to use method of simultaneous distribution. For the analysis of how auxiliary subdivisions costs influence at the prime cost and other questions of the management account it is rational to use a two-stages method of mutual distribution.

The list of the used sources. 1. С.Ф. Голов. Управлінський облік. Підручник. – 2-ге вид. – К.: Лібра, 2004. – 704 с. 2. Друри К. Введение в управленческий и производственный учет: Пер. с англ./ Под ред. С.А. Табалиной. – М. Аудит, ЮНИТИ, 1994. – 560 с. 3. Кузьменко Л.В., Ларка Н.И., Кузьменко С.Л. Совершенствование методов распределения затрат обслуживающих подразделений. Вісник Технічний прогрес і ефективність виробництва. – Харків: НТУ „ХПІ”. 2006. – № 13(1), стор. 30-33. 4. Кузьменко Л.В., Ларка Н.И., Кузьменко С.Л., Ларка Н.Н. Исследование методов распределения затрат обслуживающих подразделений. Збірник наукових статей: Управління розвитком. – Харків: ХНЕУ. 2006. – № 7 (спецвипуск), стор. 99-103. 5. Кузьменко Л.В., Ларка Н.И., Кузьменко С.Л., Ларка Н.Н. Особенности распределения затрат вспомогательных подразделений между производственными цехами. Вісник Технічний прогрес і ефективність виробництва. – Харків: НТУ „ХПІ”. 2007. – № 14, стор. 61-67.